FLAME-RETARDING EPOXY RESIN COMPOSITION

E17

Patent number: JP2138361
Publication date: 1990-05-28
Inventor: OBARA MITSUO; SUZUKI MASAHIRO
Applicant: HITACHI CHEMICAL CO LTD
Classification:
- international: C08K3/00; C08L63/00
- european:
Application number: JP19880267584 19881024
Priority number(s): JP19880267584 19881024; JP19880199652 19880810

Abstract of **JP2138361**

PURPOSE:To obtain the title composition prevented from causing the precipitation of a filler and improved in infiltrability into windings by mixing an epoxy resin with an acid anhydride, a cure accelerator, a flame retardant and a specified filler. CONSTITUTION:An epoxy resin (a) (e.g., bisphenol A epoxy resin) is mixed with 0.6-1.3 equivalents, per equivalent of the epoxy groups of component (a), of an acid anhydride (b) (e.g., methyltetrahydrophthalic anhydride), 0.1-5.0 pts.wt., per 100 pts.wt. component (b), cure accelerator (c) (e.g., 2-ethyl-4- methylimidazole), a flame retardant (d) desirably a mixture of 10-50 pts.wt., per 100 pts.wt. component (a), halogenated organic compound with 3-15 pts.wt. Sb_2O_3 and a filler (e) which is a mixture of a silica (i) having a particle diameter distribution of a mean particle diameter of 10-15mum and a cumulative weight of particles <=3mum of less than 15wt.% with a hydrated alumina (ii) having a particle diameter distribution of a mean particle diameter of 6-12mum and a cumulative weight of particles <3mum of less than 12wt.% in an amount to give a component (ii) to component (i) ratio of (40-80)/(60-20)wt.%.

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（A）　(11)特許出願公開番号

特開平7－176794

(43)公開日　平成7年(1995) 7月14日

(51)Int.Cl.⁶	識別記号	庁内整理番号	F I	技術表示箇所
H01L 33/00	N			
G09F 9/00	336 H	7610－5G		

E14

審査請求　未請求　請求項の数2　OL　（全 4 頁）

(21)出願番号　特願平5－318276

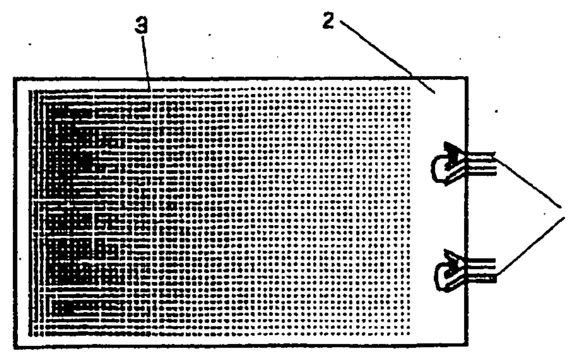
(22)出願日　平成5年(1993)12月17日

(71)出願人　000226057
日亜化学工業株式会社
徳島県阿南市上中町岡491番地100

(72)発明者　清水　義則
徳島県阿南市上中町岡491番地100　日亜化学工業株式会社内

(54)【発明の名称】　面状光源

(57)【要約】
【目的】　青色発光ダイオードを用いた白色可能な面状光源を実現し、均一な白色発光を観測できる面状光源を提供する。
【構成】　透明な導光板の端面に発光ダイオードが光学的に接続されており、さらに前記導光板の主面のいずれか一方に、前記青色発光ダイオードの発光により励起されて蛍光を発する蛍光物質と、蛍光を散乱させる白色粉末とが混合された状態で塗布された蛍光散乱層を有し、前記青色発光ダイオードの発光が前記蛍光散乱層で波長変換される。



【特許請求の範囲】

【請求項１】　透明な導光板の端面の少なくとも一箇所に青色発光ダイオードが光学的に接続されており、さらに前記導光板の主面のいずれか一方に、前記青色発光ダイオードの発光により励起されて蛍光を発する蛍光物質と、蛍光を散乱させる白色粉末とが混合された状態で塗布された蛍光散乱層を有し、前記青色発光ダイオードの発光が前記蛍光散乱層で波長変換され、前記蛍光散乱層と反対側の導光板の主面側から観測されることを特徴とする面状光源。

【請求項２】　前記青色発光ダイオードは、その主発光波長が５００ｎｍよりも短く、発光出力が５００μW以上であることを特徴とする請求項１に記載の面状光源。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明はディスプレイのバックライト、照光式操作スイッチ等に使用される面状の光源に係り、特に液晶ディスプレイのバックライトとして好適に用いることができる面状光源に関する。

【０００２】

【従来の技術】一般にノート型パソコン、ワープロ等に使用される液晶ディスプレイのバックライト用の面状光源には、例えばＥＬ、冷陰極管が使用されている。ＥＬはそれ自体が面状光源であり、冷陰極管は拡散板を用いて面状光源とされ、現在それらのバックライトの発光色はほとんどが白色とされている。

【０００３】一方発光ダイオード（以下ＬＥＤと記す。）もバックライト用光源として一部利用されている。しかしＬＥＤを用いて白色発光を得る場合、従来では青色ＬＥＤの発光出力が数十μWほどしかないため、他の赤色ＬＥＤ、緑色ＬＥＤを用いて白色発光を実現させるには、それら各色発光ＬＥＤの特性を合致させにくく色変化が大きいという欠点がある。また、三原色のＬＥＤを集合させて、同一平面上に幾何学的に同じ位置に配置しても、バックライトとしてはそれらのＬＥＤを接近した位置で視認するため、均一な白色光源にすることとは不可能であった。従って現在白色の液晶バックライトの面状光源には、大型では冷陰極管、小型～中型にはＥＬと使い分けられているのが現状で、ＬＥＤを用いた白色発光のバックライトはほとんど知られていない。

【０００４】また白色発光、あるいはモノクロの光源として、一部では青色ＬＥＤチップの周囲を蛍光物質を含む樹脂で包囲して色変換する試みもあるが、チップ周辺は太陽光よりも強い放射強度の光線にさらされるため、蛍光物質の劣化が問題となり、特に有機蛍光顔料で顕著である。更にイオン性の有機染料はチップ近傍では直流電界により電気泳動を起こし、色調が変化する可能性がある。また従来の青色ＬＥＤは蛍光物質で色変換するには十分な出力を有しておらず、たとえ色変換したとしても実用できるものではなかった。

【０００５】

【発明が解決しようとする課題】本発明はこのような欠点を解決するために成されたもので、その目的とするところは、ＬＥＤを用い、主としてバックライトとして利用できる白色発光可能な面状光源を実現すると共に、均一な白色発光を観測できる面状光源を提供することにあり、さらには白色以外の任意色の発光が可能な面状光源を提供し、信頼性に優れたＬＥＤの特性を利用し、各種操作スイッチ等に利用することにある。

【０００６】

【課題を解決するための手段】本発明の面状光源は、透明な導光板の端面の少なくとも一箇所に青色ＬＥＤが光学的に接続されており、さらに前記導光板の主面のいずれか一方に、前記青色発光ダイオードの発光により励起されて蛍光を発する蛍光物質と、光を散乱させる白色粉末とが混合された状態で塗布された蛍光散乱層（以下、蛍光散乱層側の主面を第二の主面という。）を有し、前記青色発光ダイオードの発光の一部が前記蛍光散乱層で波長変換され、前記蛍光散乱層と反対側の導光板の主面（以下発光観測側の主面を第一の主面という。）側から観測されることを特徴とする。

【０００７】図１は本発明の面状光源の導光板２を蛍光散乱層３側から見た平面図である。導光板２は例えばアクリル、硝子等の透明な材料よりなり、その導光板２の端面に青色ＬＥＤ１が埋設されることにより、導光板２と青色ＬＥＤ１とが光学的に接続されている。なお本発明において、青色ＬＥＤ１と導光板２の端面とが光学的に接続されているとは、簡単に言えば、導光板２の端面から青色ＬＥＤの光を導入することをいい、例えばこの図に示すように青色ＬＥＤ１を埋設することはもちろんのこと、青色ＬＥＤを接着したり、また、光ファイバー等を用いて導光板２の端面に青色ＬＥＤの発光を導くことによって実現可能である。

【０００８】次に、蛍光散乱層３は、所望の色が観測できるように、蛍光物質と白色顔料とを調合したインクが塗布されてなり、青色ＬＥＤ１の発光を蛍光物質で波長変換すると同時に、白色顔料でその蛍光を導光板２内に散乱させている。特に図１では前記蛍光散乱層３をドット状とし、第一の主面側の表面輝度が一定となるように、ＬＥＤ１に接近するにつれて、第二の主面側の単位面積あたりの蛍光散乱層３の面積を減じるようなパターンとし、さらにはＬＥＤ１と最も離れた第二の主面の端部の面積はやや最大面積に比して若干小さくしている。ここで、図１中の■は蛍光散乱層３のパターンを表している。図１では青色ＬＥＤを一つの端面に２個配した構造としているが、導光板が四角形であれば四方の端面全てにＬＥＤを接続してもよいことはいうまでもなく、ＬＥＤの個数も限定するものではない。さらに、ＬＥＤの配置状況により、第一の主面側から観測する発光を面状均一とするように蛍光散乱層の塗布形状、塗布状態を適

宜変更することができる。

【0009】

【作用】図2は本発明の面状光源を例えば液晶パネルのバックライトとして実装した場合の模式断面図である。これは図1に示す面状光源の第二の主面側に、例えばチタン酸バリウム、酸化チタン、酸化アルミニウム等よりなる散乱反射層6と、例えばＡｌよりなるベース7とが積層された反射板を設置し、第一の主面側に表面が凹凸とされている光拡散板5を設置しており、これらの構成は光源を冷陰極管とするバックライトと特に変わるものではない。

【0010】まず図2の矢印で示すように、青色ＬＥＤ1から出た光は、チップ近傍で一部導光板以外の外部に放射されるが、大部分の光は導光板2の中を全反射を繰り返しながら、導光板の端面に達する。端面に達した光は端面全てに形成された反射膜4に反射されて、全反射を繰り返す。この時、導光板2の第二の主面側に設けられた蛍光散乱層3により一部の光は散乱され、また一部の光は蛍光物質により吸収され同時に波長変換されて放射され、導光板2の第一の主面側から観測する発光色はこれらの光を合成した光が観測できる。例えば橙色の蛍光顔料と白色顔料からなる蛍光散乱層3を設けた面状光源では、先に述べた作用により、青色ＬＥＤからの発光色が白色となって観測できる。また色調は蛍光物質の種類と白色顔料の混合比により任意に調整できる。特に本発明では一つの青色ＬＥＤの発光波長はその主発光ピークが５００ｎｍよりも短く、その発光出力は２００μＷ以上、更に好ましくは３００μＷ以上の出力が必要である。なぜなら発光波長が５００ｎｍ以上であると全ての色が実現しにくくなり、またその発光出力が２００μＷよりも少ないと、たとえ導光板の端面に光学的に接続する青色ＬＥＤの数を増やしても、充分な明るさの均一な面状発光の光源が得られにくい傾向にあるからである。

【0011】

【実施例】

［実施例1］厚さ約２ｍｍのアクリル板の片面に、図1に示すドット状のパターンで、蛍光散乱層3をスクリーン印刷により形成した。蛍光散乱層3は、赤色蛍光顔料であるシンロイヒ化学製ＦＡ－００１と緑色蛍光顔料である同社製ＦＡ－００５とを等量に混合した蛍光顔料と、白色粉末としてチタン酸バリウムとを重量比で1：5の割合で混合し、それをアクリル系バインダー中に分散したものを印刷して形成した。

【0012】次に上記のようにして蛍光散乱層が形成されたアクリル板を、所望のパターンに従って切断し、アクリル板の端面（切断面）を全て研磨した後、研磨面にＡｌよりなる反射層4を形成することにより、蛍光散乱層3が形成された導光板2を得た。

【0013】前記導光板2の端面に二箇所、穴を設け、その穴に発光波長４８０ｎｍ。発光出力１２００μＷを有する窒化ガリウム系化合物半導体よりなる青色ＬＥＤをそれぞれ1個づつ埋め込むことにより、本発明の面状光源を得た。この面状光源の青色ＬＥＤを同時に点灯させたところ、導光板2の発光観測面側からはやや黄色みを帯びた白色のほぼ均一な面状発光が得られた。さらに、発光観測面側に予めマット加工が施された光拡散板5と、蛍光散乱層3側にＡｌベース7上にチタン酸バリウム層6が塗布された反射板を設置して、バックライト用光源としたところ、光拡散板5側から完全に面状均一な白色発光が得られた。輝度は５５ｃｄ／m²であった。

【0014】［実施例2］蛍光散乱層3を、黄色蛍光染料としてＢＡＳＦ社のＬｕｍｏｇｅｎＦ　Ｙｅｌｌｏｗ－０８３と橙色蛍光染料として同社製Ｏｒｅｎｇｅ－２４０とをほぼ等量混合し、それらをブチルカルビトールアセテートに溶解した蛍光染料と、白色物質としてチタン酸バリウムとを重量比で1（染料）：２００の割合で混合したものを用いて形成する他は、実施例1と同様にして本発明の面状光源を得たところ、ほぼ均一な面状発光が観測された。さらに同様にしてバックライト用光源としたところ、完全に均一な面状発光が観測された。

【0015】

【発明の効果】以上説明したように、本発明の面状光源は、青色ＬＥＤを用い、しかも導光板の片方の面に青色ＬＥＤにより波長変換できる蛍光物質と白色粉末とを含有した蛍光散乱層を有していることにより、信頼性に優れたＬＥＤによる面状光源を実現することが可能となった。しかも蛍光散乱層の白色粉末は、蛍光物質により波長変換された光を反射、拡散させる作用があるため、使用する蛍光物質の使用量が少なくて済む。更に好都合なことには、ＬＥＤチップと蛍光物質とが直接接することがないので、蛍光物質の劣化が少なく、長期間に渡って面状光源の色調変化を起こすことがない。さらに、色調に関しては、蛍光物質、白色粉末の種類、混合量等を変更することにより、白色を含め任意の色調を提供することができる。

【0016】一方蛍光散乱層を励起する側として、最も好ましくは使用する青色ＬＥＤの発光出力が２００μＷ以上のものとすることにより、蛍光物質により効率的に波長変換して大きな面積の明るい面状光源を実現することができる。このように、本願の面状光源は、バックライト用光源とだけでなく、蛍光物質を利用した照光式操作スイッチ等に利用することもできる。

【図面の簡単な説明】

【図1】　本発明の一実施例の面状光源の導光板2を蛍光散乱層3側から見た平面図。

【図2】　本発明の一実施例の面状光源をバックライトとして実装した場合の模式断面図。

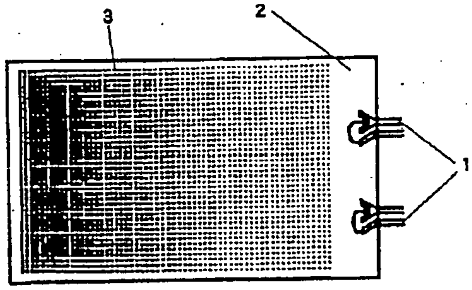
【符号の説明】

1・・・・・青色ＬＥＤ

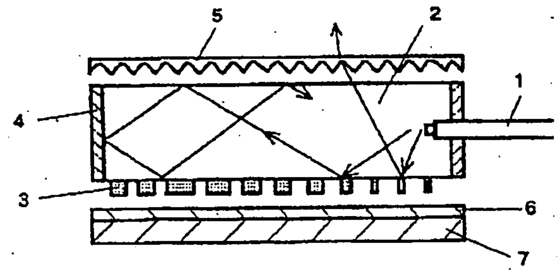
2・・・・・導光板
3・・・・・蛍光散乱層
4・・・・・反射層

＊5・・・・・光拡散板
6・・・・・散乱反射層
＊ 7・・・・・Ａｌベース

【図1】



【図2】



E 14a

(7-176794)

(54) [TITLE OF THE INVENTION] PLANAR LIGHT SOURCE

(57) [ABSTRACT]

[Purpose] To realize a planar light source using a blue light-emitting diode and being capable of allowing white color and to provide a planar light source capable of allowing observation of uniform white color light emission.

[Construction] A light-emitting diode is optically connected to an end surface of a transparent optical guiding plate, and either one of the principal surfaces of said optical guiding plate includes a fluorescent scattering layer in which a fluorescent substance emitting a fluorescence by being excited with the light emission of said blue light-emitting diode and a white powder scattering the fluorescence are applied in a mixed state, whereby the light emission of said blue light-emitting diode is wavelength-converted by said fluorescent scattering layer.

[CLAIMS]

[Claim 1] A planar light source characterized in that a blue light-emitting diode is optically connected to at least one place of an end surface of a transparent optical guiding plate, and either one of the principal surfaces of said optical guiding plate includes a fluorescent scattering layer in which a fluorescent substance emitting a fluorescence by being excited with the light emission of said blue light-emitting diode and a white powder scattering the fluorescence are applied in a mixed state, whereby the light emission of said blue light-emitting diode is wavelength-converted by said fluorescent scattering layer

and observed through a principal surface side of the optical guiding plate opposite to said fluorescent scattering layer.

[Claim 2] A planar light source as set forth in claim 1, characterized in that said blue light-emitting diode has a principal light-emission wavelength of less than 500 nm and a light emission output power of 500 μW or more.

[Detailed Description of the Invention]

[0001]

[Industrially Applicable Field] The present invention relates to a planar light source used as a back light of a display, an illuminating operation switch, or the like, and more particularly, to a planar light source capable of being suitably used as a back light of a liquid crystal display.

[0002]

[Prior Art] Generally, an EL or a cold cathode tube, for example, is used as a planar light source for a back light of a liquid crystal display to be used in a notebook type personal computer, a word processor, or the like. The EL is a planar light source in itself, and the cold cathode tube is made into a planar light source by using a scattering plate. At present, almost all of the light emission colors of these back lights are assumed to be a white color.

[0003] On the other hand, a light-emitting diode (hereafter referred to as an LED) is also used as a light source for a back light in some cases. However, in the case where a

white color is to be obtained by using the LED, since the light emission output power of a blue LED is as small as several ten μW in the prior art, in order to realize a white color light emission by using other red LED and green LED, there is a defect that it is difficult to match the characteristics of the LEDs of these colors, leading to a large color change. Also, even if the LEDs of the three primary colors are assembled and placed geometrically at the same position on the same plane, these LEDs are observed at the proximity positions as a back light, so that it was impossible to make a uniform white light source. Accordingly, currently as planar light sources of a white liquid crystal back light, a cold cathode tube is used for large sizes, while an EL is used for small to medium sizes. Almost no back light of a white color emission using an LED is known.

[0004] Also, as a white light emission light source or monochromatic light source, there is an attempt to convert the color by covering the periphery of a blue LED chip with a resin containing a fluorescent substance. However, since the periphery of the chip is exposed to light beams having a stronger radiation intensity than the solar light, deterioration of the fluorescent substance becomes a problem, and especially it is conspicuous in the case of an organic fluorescent pigment. Further, ionic organic dyes generate electrophoresis by a direct current electric field in the vicinity of the chip, leading to the possibility of color tone changes. In addition, the conventional blue LED does not have a sufficient output power for color conversion using a fluorescent substance and, even if the color conversion is carried out, it could not be put into practical use.

[0005]

[Problems to be Solved by the Invention] The present invention has been made in order to solve these problems and its purpose is to realize a planar light source capable of emitting a white color that can be used as a back light by using a LED and to provide a planar light source capable of allowing observation of a uniform white color light emission. Further, the purpose is to provide a planar light source capable of emitting an arbitrary color other than white, and to apply it for various operation switches and the like by utilizing the characteristics of the LED being excellent in reliability.

[0006]

[Means for Solving the Problems] The planar light source of the invention is characterized in that a blue LED is optically connected to at least one place of an end surface of a transparent optical guiding plate, and either one of the principal surfaces of said optical guiding plate includes a fluorescent scattering layer in which a fluorescent substance emitting a fluorescence by being excited with the light emission of said blue light-emitting diode (hereafter the principal surface on the fluorescent scattering layer side is referred to as a second principal surface) and a white powder scattering the fluorescence are applied in a mixed state, whereby a part of the light emission of said blue light-emitting diode is wavelength-converted by said fluorescent scattering layer and observed through a principal surface side of the optical guiding plate opposite to said fluorescent scattering layer (hereafter the principal surface on the light emission observing side is referred to as a first principal surface).

[0007] FIG. 1 is a plan view of an optical guiding plate 2 of the planar light source of the invention as viewed from a fluorescent scattering layer side 3. The optical guiding plate 2 is made, for example, of a transparent material such as an acrylic resin or glass. The optical guiding plate 2 is connected to a blue LED 1 by burying and disposing the blue LED 1 in an end surface of the optical guiding plate 2. Here, in the present invention, the blue LED 1 being optically connected to the end surface of the optical guiding plate 2 refers, in short, to introduction of light of the blue LED through the end surface of the optical guiding plate 2. For example, it can be realized by bonding the blue LED or by guiding the light emission of the blue LED to the end surface of the optical guiding plate 2 using an optical fiber or the like, not to mention burying and disposing the blue LED 1 as shown in this figure.

[0008] Next, the fluorescent scattering layer 3 is made by applying an ink in which a fluorescent substance and a white pigment are blended so that a desired color can be observed. The fluorescent scattering layer 3 converts the wavelength of the light emission of the blue LED 1 by means of the fluorescent substance and at the same time, scatters the fluorescence within the optical guiding plate 2 by means of the white pigment. Especially, in FIG. 1, said fluorescent scattering layer 3 is made into dots, and made into a pattern by which the area of the fluorescent scattering layer 3 per unit area on the second principal surface side decreases so that the surface brightness of the first principal surface side becomes constant, according as it approaches the LED 1. Further, the area of the end portion of the second principal surface located at the largest distance from the

LED 1 is made to be a little smaller than the maximum area. Here, the symbol ■ in FIG. 1 represents a pattern of the fluorescent scattering layer 3. FIG. 1 shows a construction in which two blue LEDs are disposed on one end surface. However, it goes without saying that LEDs can be connected to four end surfaces if the optical guiding plate is a quadrangle, and also the number of the LEDs is not limited. Furthermore, depending on the arrangement of the LEDs, the application configuration and the application state of the fluorescent scattering layer can be suitably changed so as to obtain a planarly uniform light emission as observed through the first principal surface side.

[0009]

[Action] FIG. 2 is a cross-sectional model view in the case where the planar light source of the invention is mounted, for example, as a back light of a liquid crystal panel. This includes a reflecting plate disposed on the second principal surface side of the planar light source shown in FIG. 1, the reflecting plate being a laminate of a scattering reflecting layer 6 made, for example, of barium titanate, titanium oxide, aluminum oxide, or the like and a base 7 made, for example, of Al, and includes a light scattering plate 5 disposed on the first principal surface side, the light scattering plate 5 having an uneven surface. This construction is not particularly different from the back light in which a cold cathode tube is used as the light source.

[0010] First, as shown by an arrow of FIG. 2, the light emitted from the blue LED 1 is partly radiated from a place adjacent to the chip to the outside other than the optical

guiding plate, but almost all of the emitted light reaches an end surface of the optical guiding plate while repeating the total reflection in the optical guiding plate 2. The light having reached the end surface is reflected by a reflecting film 4 formed on all the end surfaces to repeat the total reflection. At this time, a part of the light is scattered by the fluorescent scattering layer 3 disposed on the second principal surface side of the optical guiding plate 2, and a part of the light is absorbed by the fluorescent substance and at the same time, is wavelength-converted to radiate. The emission color observed through the first principal surface side of the optical guiding plate 2 is a synthesized light of these lights. For example, in a planar light source in which a fluorescent scattering layer 3 made of an orange fluorescent pigment and a white pigment is disposed, the light emission color from the blue LED can be observed as a white color by the aforementioned action. Further, the color tone can be arbitrarily adjusted by the kind of the fluorescent substance and the mixing ratio of the white pigment. Especially, the invention requires that the light emission wavelength of one blue LED has a main light emission peak shorter than 500 nm, and a light emission output power of not less than 200 μW, more preferably not less than 300 μW. This is because, if the light emission wavelength is 500 nm or more, it is difficult to realize all the colors, and if its light emission output power is smaller than 200 μW, there is a tendency that it will be difficult to obtain a light source of uniform planar light emission with sufficient brightness even if the number of blue LEDs to be optically connected to the end surface

of the optical guiding plate is increased.

[0011]

[Examples]

[Example 1] A fluorescent scattering layer 3 was formed by screen printing in a dot-like pattern shown in FIG. 1 on one surface of an acrylic plate having a thickness of about 2 mm. The fluorescent scattering layer 3 was formed by printing a substance obtained by dispersing into an acrylic binder a mixture of containing a fluorescent pigment and barium titanate as a white powder at a weight ratio of 1 : 5. The fluorescent pigment had been obtained by mixing FA-001 made by Synreuch Chemical Co., Ltd. as a red fluorescent pigment and FA-005 made by the same company as a green fluorescent pigment in equal amounts.

[0012] Next, the acrylic plate having the fluorescent scattering layer formed as mentioned above is cut in accordance with a desired pattern and, after all the end surfaces (cut surfaces) of the acrylic plate are polished, reflecting layers 4 made of Al were formed on the polished surfaces to give an optical guiding plate 2 having the fluorescent scattering layer 3 formed thereon.

[0013] Holes were formed at two places on the end surface of said optical guiding plate 2, and one blue LED made of a gallium nitride compound semiconductor having a light emission wavelength of 480 nm and a light emission output power of 1200 μW was buried respectively in each of the holes to provide the planar light source of the invention.

When the two blue LEDs of the planar light source were turned on at the same time, a white and almost uniform planar light emission with a yellowish color was obtained through the light emission observing side of the optical guiding plate 2. Further, a light scattering plate 5 made to mat-processing beforehand was disposed on the light emission observing side, and a reflecting plate having a barium titanate layer 6 applied on an Al base 7 was disposed on the fluorescent scattering layer 3 side to prepare a light source for a back light, whereby a complete planarly-uniform white light emission was obtained through the light scattering plate 5 side. The brightness was 55 cd/m^2.

[0014] [Example 2] A planar light source of the invention was obtained in the same manner as in Example 1, except that the fluorescent scattering layer 3 was formed by using a mixture of a fluorescent dye and barium titanate as a white substance in a weight ratio of 1 (dye) : 200. The fluorescent dye had been obtained by mixing almost equally in weight Lumogen F Yellow-083 made by BASF Co., Ltd. as a yellow fluorescent dye and Orenge-240 made by the same company as an orange fluorescent dye, and dissolving the mixture in butylcarbitol acetate. An almost uniform planar light emission was observed. Further, a light source for a back light was prepared in a similar manner, whereby a complete planarly-uniform light emission was observed.

[0015]

[Effects of the Invention] As described above, the planar light source of the invention uses a blue LED, and includes a fluorescent scattering layer containing a fluorescent substance capable of wavelength conversion with the blue LED and a white powder on

one surface of the optical guiding plate, so that the present invention has made it possible to realize a planar light source with a LED which is excellent in reliability. Furthermore, since the white powder of the fluorescent scattering layer acts to reflect and diffuse light wavelength-converted by the fluorescent substance, the amount of the fluorescent substance to be used is reduced. A further advantage is that, since the LED chip and the fluorescent substance are not brought into direct contact, deterioration of the fluorescent substance is small and the color tone change of the planar light source is prevented for a long period of time. In addition, as to the color tone change, an arbitrary color tone including a white color can be provided by varying the kinds of the fluorescent substance and the white powder, the mixing amount, and the like.

[0016] In the meantime, a bright planar light source having a large area can be realized by conducting an effective wavelength conversion with the fluorescent substance by using most preferably a blue LED having a light emission output power of 200 μW or more for exciting the fluorescent scattering layer. As described above, the planar light source of the invention can be used not only as a light source for a back light but also as for an illuminating operation switch or the like utilizing a fluorescent substance.

[Brief Description of the Drawings]

[FIG. 1] A plan view of an optical guiding plate 2 of a planar light source of one embodiment of the present invention as viewed from a fluorescent scattering layer 3 side.

[FIG. 2] A cross-sectional model view in the case where a planar light source of one

embodiment of the present invention is mounted as a back light.

[Explanation of numerals]

1 ... blue LED

2 ... optical guide plate

3 ... fluorescent scattering layer

4 ... reflecting layer

5 ... optical scattering plate

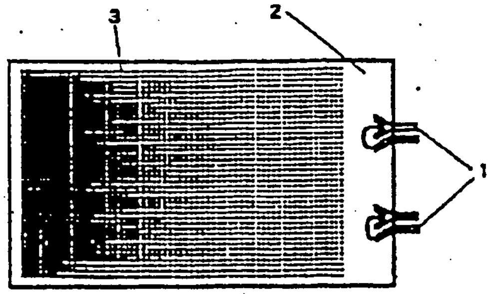
6 ... scattering reflecting layer

7 ... Al base

138

2・・・・・導光板
3・・・・・蛍光散乱層
4・・・・・反射層
5・・・・・光拡散板
6・・・・・散乱反射層
7・・・・・Alベース

【図1】



【図2】